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PW431D
HARDWARE USER MANUAL

VERSION: **PW431D-AE-5.03**
DATE : **14/07/2011**

Notes

Before test, ground the main machine to avoid inductive static electricity that might occur on the running tester.

Be careful of voltage output, especially over 36V, to aviod electric shock hazards.

The voltage and current output terminals of the tester should NEVER import other voltage and current sources. During test, if the testing protection equipment feedbacks the voltage to the tester, it might cause damage. So be careful.

Break off the outside circuit of the protection equipment to ensure the accuracy of the test. Besides, ground the voltage N and current N at the same point.

The tester is only used as a testing tool for the protection equipment. DC power supply (0-300V, 150W) could offer DC power supply for the protection equipment but not for the protection circuit.

There are some heat sinks for wind ventilation located on the front, back or bottom of the main machine. Don’t cover or block the heat sink, which might cause unusual situations.

The machine could not be located in an open place that might catch raining.

Collect the main machine into packing box when not in use. For cleaning the machine, unplug electronics firstly and then use cleaner or stupe to do it.

Handle the computer with care, and assign special staff for that.

When the device works abnormally, please contact the factory and don’t try to fix by your own.

Content

1. Characteristics and Technical Parameters

1.1 Characteristics

1.1.1 The signal processing platform is built on latest United States DSP and integrated with advanced FPGA technology, which offers strong signal processing ability.
1.1.2 The amplifier has smooth and real output waveform without burrs , which is high performance and extremely reliable and not like switch amplifiers that easily produce high-order harmonic. It doesn't have the burr problem that might cause inaccurate settings, so it gives great measuring accuracy on broad-use high-performance quick protection equipments.
1.1.3 The real and accurate small current wave causes no electromagnetic pollution and won't interfere any electrical devices on the test site.
1.1.4 The I_a, I_b, I_c indication lights on the panel will flame in certain combinations to identify current distortion situations caused by open circuit or overload resistance of the current source type current output circuit.
1.1.5 Under voltage distortion situations caused by short circuit or overload of the voltage source type voltage output circuit, the distortion detection circuit will automatically shut down the voltage amplifier and flame the indication light on the panel to identify short-circuit of voltage output. If the short-circuit or overload situations were fixed, the voltage amplifier will recover to work automatically.
1.1.6 Binary inputs can be electrically isolated from each other and compatible with dead contacts and 15V-220V DC potential. The potential polar can be automatically identified, which gives lots of benefitial to application and field wiring.
1.1.7 The manual soft startup mode improves the reliability of the power and shield the impact on the testing protection equipment and electric network when startup, so that it protects the testing machine from mis-startup because of turning on/off the tester.
1.1.8 Mass wind-cooling heat sink has separated wind tunnels and electronic parts mounted on the electrical board inside the machine case, and formed negative voltage to resist the pollution of harmful gas and dust to keep long-term cleaning inside the case. Its

intelligent wind system can control the wind volume according to the temperature sensor mounted inside the case. Under normal working situation, the wind system works at a quiet and low speed. When the temperature inside the case was rised up to 50℃, the wind system will speed up to largely upgrade its heat dissipation ability. The delicate structure and heat dissipation design not only improves the equipment’s ability to tolerate heavy-load, large current and long-time working but also its stability and reliability.

1.2 Technique Parameters

Voltage Generators

Item	Setting range	Power
4-phase ac(L-N)	4×0...150V	4 x 60VA at 150V
1-phase ac(L-L)	2×0 ... 300V	2 × 120 VA at 300V (two generators in series)
dc(L-N)	4×0...±150V	4 × 40 W at ±150 V
dc(L-N)	1×0~±300V	1×80W at ±300V

Item	Parameters
Accuracy	error < 0.08 % rd. + 0.02 % rg. guar.， at 0~150V error < 0.04 % rd.+ 0.01 %rg. typ.， at 0~150V
Ranges	150V
Resolution	5mV for 150Vac
Distortion	< 0.05 % typ. (< 0.1 % guar.)

Current Generators

Item	Setting range	Power
6-Phase AC (L-N)	6×0...15A	6x150VA at 15A
3-Phase AC (L-N)	3×0...30A	3 ×240VA at 30A
1-Phase AC (3L-N)	1×0...90A	1 ×450VA at 90A
DC (3L-N)	1×0...±60A	1×480W at ±60A

Item	Parameters
Max compliance voltage(L-N)(L-L)	15Vpk/32Vpk
Accuracy	error < 0.15 % rd . + 0.05 % rg. guar.， at 0~15A error < 0.05 % rd.+ 0.02 %rg. typ.， at 0~15A
Ranges	15A
Resolution	1mA
Distortion	< 0.05 % typ. (< 0.1 % guar.)

General

Frequency

Sine signal	DC, 1 ...2000Hz
Transient signal	dc …10.0 kHz
Accuracy	±1ppm
Resolution	0.001 Hz

Phase

Angle range	-360 º to 360º (Lead)
Accuracy	<0.05° typ., <0.1° guar. at 50/60Hz
Resolution	±0.01°

Binary inputs

Number	8
Inputcharacteristics	0 ~ 400Vdc threshold or potential free
Timeresolution	50μs
Max.measuring time	infinite
Debounce/Deglitch time	0~25ms
Countingfunction	< 3kHz at pulse width＞150 μs

Binary outputs

Number	4（1-4, front side）
Type	Potential free relay contacts, software controlled
Break capacity ac	Vmax: 300Vac/Imax: 8A /Pmax: 2000VA
Break capacity dc	Vmax: 300Vdc/Imax: 8A /Pmax: 150W
Number	4（5-8, rear side）**optional**
Type	semiconductor
Break capacity ac	Vmax: 300Vac/Imax: 0.5A /Pmax: 150VA
Break capacity dc	Vmax: 300Vdc/Imax: 0.5A /Pmax: 150W

Auxiliary dc supply

Voltage range	0～300V
Power	88W at 110V, 176 W at 220V, 120W at 300V
Accuracy	Error<0.1%rg. typ. (<0.5%rg.guar.)

DC voltage measuring inputs

Measuring range	0~±10V
Accuracy	Error<0.02%rg.typ.(<0.05%rg.guar.)
Input impedance	100kΩ

DC current measuring inputs

Measuring range	0~±20mA
Accuracy	Error<0.02%rg.typ.(<0.05%rg.guar.)
Input impedance	50Ω

Power supply

Nominal input voltage	100~240Vac
Permissible input	90~ 260Vac
Nominal frequency	50/60Hz
Permissible frequency	45~65Hz

Environmental conditions

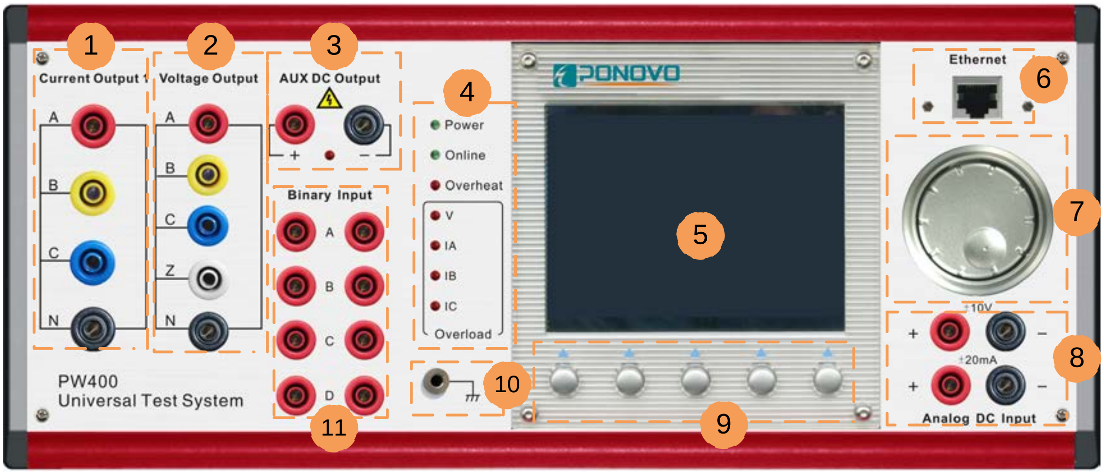
Operation temperature	0 ...+50°C
Storage temperature	-25 ...+70°C
Relative humidity	5...95% non – condensing
EMC (Emission)	IEC61000-3-2/3
EMC (Immunity)	IEC61000-4-2/3/4/5/6/11
Safety	IEC 61010-1

Others

PC connection	Ethernet
Local display	color LCD,4.7’
GPS interface	RS232
Ground Socket (earth)	4 mm banana socket; front side
Weight	20kg
Dimensions(W × H × D)	360 mm× 157mm× 367 mm

2. Panel and Operation Guide

2.1 Front Panel



（1） Current OutputA,B,C,N

（2） Voltage OutputA,B,C,Z,N

（3） Auxiliar DC Output

（4） Indication Light（Power, Online, Overheat, Overload:V, IA, IB, IC, Ia, Ib, Ic）

（5） LCD display: **service life of LCD backlight is 50 thousand hours**

（6） Communication Interface of Computer（Ethernet）

（7） regulation button：also it can be used as **Enter** key

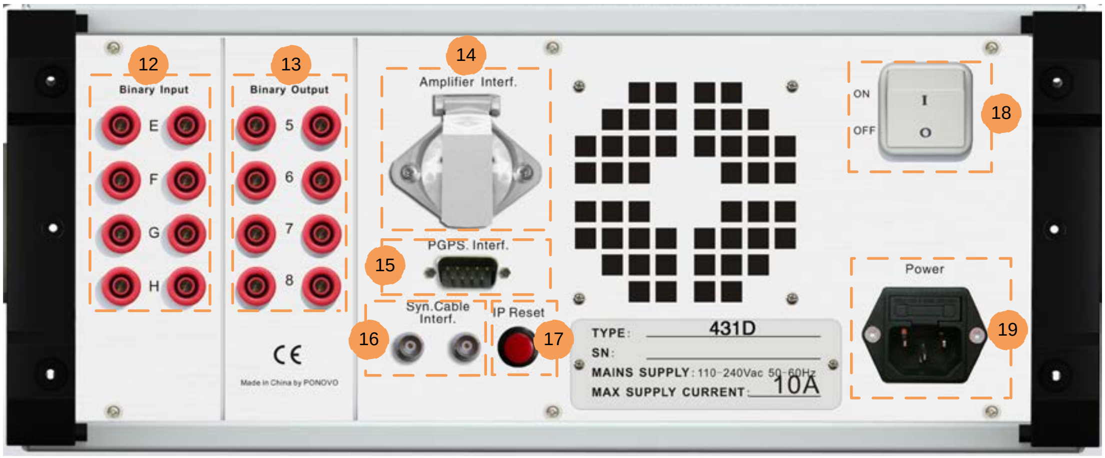
（8） DC measurement Interfaces

（9） Function key in test screen during offline run

（10） Ground Terminal

（11） Binary Input A,B,C,D

2.2 Rear Panel



（12） Binary Input E,F,G,H

（13） Binary Output 5,6,7,8 (**optional**)

（14） Amplifier Interface

（15） PGPS interface

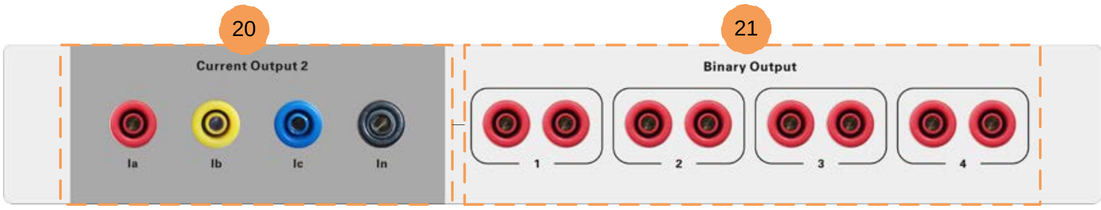
（16） Local synchronization interfaces

（17） IP Reset button

（18） Power Switch

（19） Power Socket

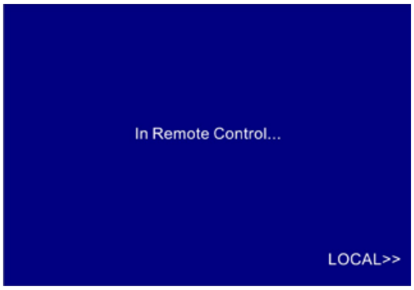
2.3 Top Panel

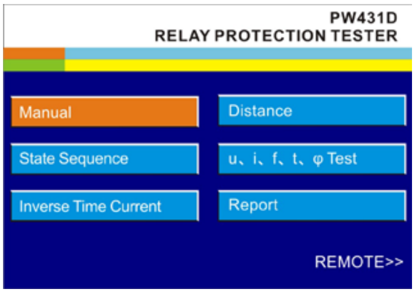


(20) Current Output 2, Ia, Ib, Ic, In

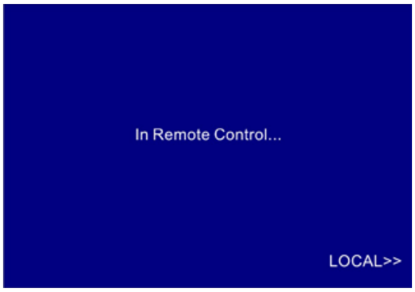
(21) Binary Output 1, 2, 3, 4

3. PC control and Local control





[1] Pressing down the button where the word “Remote” is displayed in main menu interface, you can swich to external PC control mode. Then, connect the external computer to PW431D with an ethernet cable, and reset the IP address of the control computer.
Detail information about external computer control, please refer to “PowerTest software manual”.
[2] Pressing down the button where the word “local” is displayed in main menu interface, you can swich to local control mode.



4. System Overview

4.1 System Overview

The PWD series tester is a kind of relay protection tester that can not only run online with accessible notebook computer but also run offline, applying the advanced international upper computer and lower computer design idea. For the online run with notebook computer, the notebook computer is appointed as upper computer and DSP is appointed as lower computer; for offline run, micro-controller is appointed as upper computer, while DSP is the lower computer. Since the calculation and the output control are accomplished by DSP+FPGA, the hardware parameter index for offline run is identical with the peer for online run with notebook computer. Refer to the user's manual of PW series relay protection tester for detail.

4.2 Test Function

1. Manual test: This unit can output 4-line AC voltage, 3-line AC current, 1-line DC voltage and 3-line DC current to realize the manual control over DC variable's amplitude, AC variable's amplitude, phase and frequency according to the steps.
2. Distance test: This unit can carry out the setting check, the logic check and the switch transmission test for circuit protection.
3. State sequence test: This unit can control complex process flexibly: it can define 8 continuous test states at most that can be set of its voltage, current amplitude and phase at will, switching among states by time or triggered by binary input.
4. u、i、f、t、φ test: This unit can carry out the tests over frequency action value, frequency action time, AC action value, AC action time, DC action value, DC action time.
5. Inverse time current: this unit is to test on inverse time current protection function, which gets two ways to display the test result: the list and the diagram.

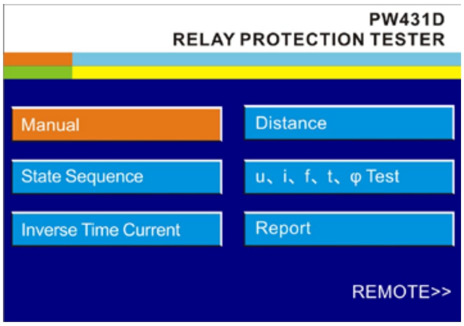


Fig. 4.1

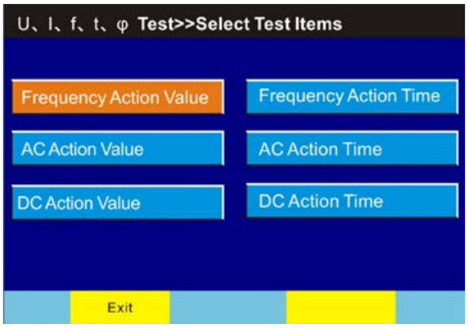


Fig 4.2

4.3 Operation Introduction

4.3.1 How to select menu

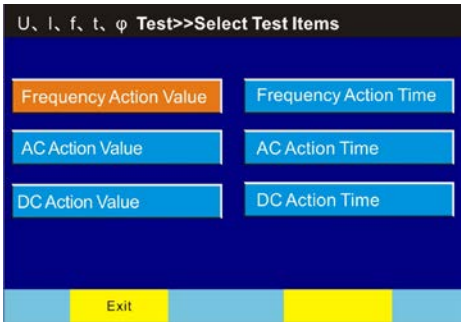


Fig. 4.3

The cursor is moved on the menu by controlling the rotary encoder; when the cursor reaches the target, press the encoder to go to the menu just selected.

4.3.2 How to set parameters and select parameters

1. How to set selectable type of parameters

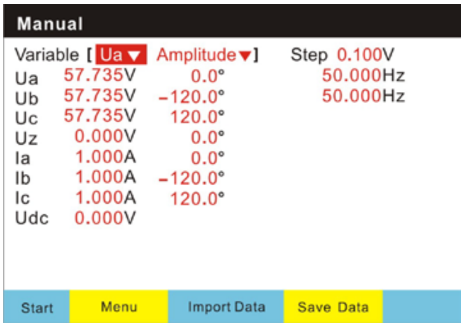


Fig. 4.4

- Turn around the rotary encoder to move the cursor to the parameter to be selected, which will become orange by then.
- Press the rotary encoder, the selected parameter will become dark blue.
- Turn around the rotary encoder to find the parameter to be selected.
- Press the rotary encode to confirm the selection. By then, the parameter selected will become orange, which means the parameter selection is done.

  2. How to set numerical type of parameters

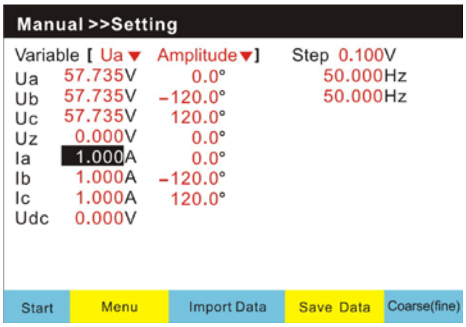


Fig. 4.5

- Turn around the rotary encoder to move the cursor to the parameter to be selected, which will become orange by then.
- Press the rotary encoder and the parameter selected will become dark blue and at the same time at right bottom corner of the screen there will appear the coarse(fine) adjustment function key, which can switch between coarse adjustment and fine adjustment.
- Turn around the rotary encoder to set parameter. When the coarse(fine) adjustment option is shown up, the number before the decimal point can be adjusted; when the fine(coarse)

adjustment is shown up, the number behind the decimal point can be adjusted.

- Press the rotary encoder to confirm the parameter setting, by then the parameter selected will become orange, which means the parameter setting is done.

4.4 How to import and save parameters

- The parameter setting for each test is available to be saved and imported. There has the storage room that could contain at most 10 groups of parameters, including 3 groups of default parameters and 7 groups of customized parameters. The default parameter is named after its function, e.g. “10V negative-sequence voltage”. The customized parameter is named after its saving time.

Fig. 4.6

On the “Parameter Setting” screen for each test, press “Save Parameter” key to go to the “Save Parameter” screen. No.0 to 3 groups are for default parameters. Turn around the knob to switch the cursor between the 4 to 9 groups of parameters in sequence. When the cursor is moved to the right position, press the knob or the “Confirm” key to save the current testing parameters, which will change their names to the current time. Press “Exit” key to exit the “Parameter Setting” screen.

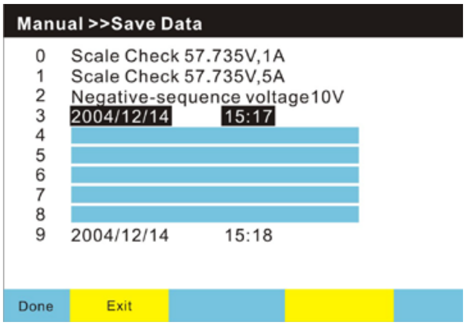


Fig. 4.7

On “Parameter Setting” screen for each test, press “Import Parameter” key to go to the “Read Parameter” screen. Turn around the knob to switch the cursor among No.0 to 9 groups of parameters. When position the cursor correctly, press the knob or the “Confirm” key, the testing parameter selected will be imported as the current parameter, and the screen will exit to the “Parameter Setting” screen automatically. If there has no parameter saved on the cursor to be confirmed, the operation will be invalid. Press “Exit” key to exit to the “Parameter Setting” screen.

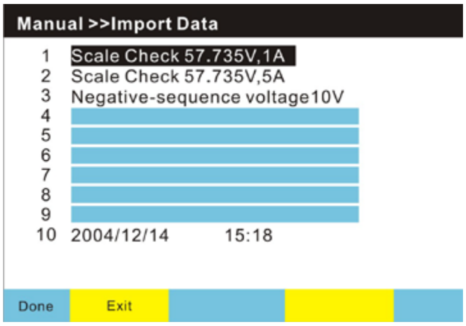

Manual >>Import Data
1 Scale Check 57.735V,1A
2 Scale Check 57.735V,5A
3 Negative-sequence voltage10V
4
5
6
7
8
9
10 2004/12/14 15:18
Done
Exit

Fig. 4.8

4.5 How to save and view report

- All test results can be saved as reports except manual test, which users can view after tests. The report is named after the saving time of the report plus the test name. There can save 20 groups of reports at most.

Fig. 4.9

- After test, press the “Save as Report” key on “Test Result” screen for each test to save current test result. During saving, there has a notice of “Saving report” displayed at the left bottom of the screen, which will show “Report has been saved” after the process is done.

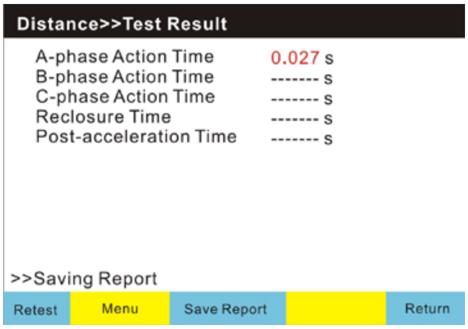


Fig. 4.10

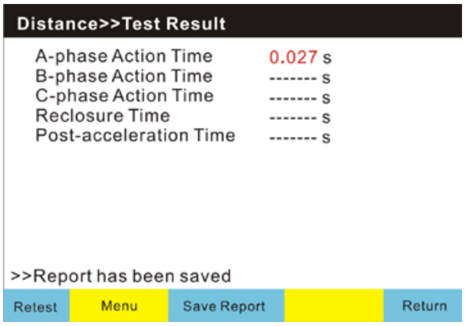


Fig. 4.11

- Turn around the knob in main menu. When the cursor points to “View Test Report”, press the knob to go to the “View Test Report” screen. No.0 to 9 groups of reports will be displayed in the saving sequence on the screen automatically. Press “Next Page” key to view No.10 to 19 groups of reports; press “Previous Page” to return to No.0 to 9 groups. The cursor can be switched among all groups of reports by turning around the knob. When position the cursor correctly, press the knob or the “Confirm” key to go to the “View Report”

screen for corresponding test results. Press the “Return to Menu” key on the “View Report” screen to go back to “View Test Report” screen. Press the “Exit” key on the “View Test Report” screen to exit to main menu.

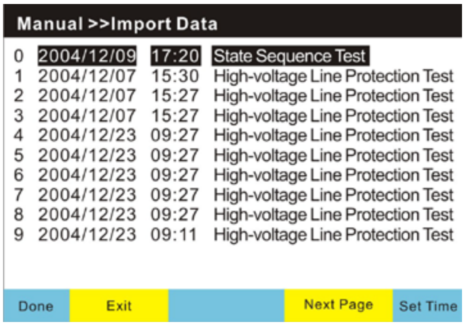


Fig. 4.12

4.6 How to set system time

PWD tester has its own real-time clock, which can be calibrated by setting current time on the “Set Time” screen. The time information is useful during parameter and report saving processes.
Press the “Set Time” key on the “View Test Report” screen to go to its screen. Turn around the knob to switch among Year, Month, Day, Hour, Minute, Second time units. Press the knob when got right number, the cursor will become blue. By then, the magnitude of time units can be altered by turning around the knob. After this altering, press the knob again, the cursor will recover to orange and be able to be switched among time units again. Press “Confirm” key, the time setting will be saved and the screen will exit to “View Test Report” automatically. Press “Exit” key, the time value won't be saved and the screen will exit to main menu.

Fig. 4.13

5. Manual Test

5.1 Overview

This unit can output 4-line AC voltage, 3-line AC current, 1-line DC voltage and 3-line DC current, which can realize manual control over DC variable's amplitude, AC variable's amplitude, phase and frequency according to the steps.

5.2 Parameters

1. Selectable type of variable:

Ua	Amplitude	Phase	Frequency
UbUc	Amplitude	Phase	
UaUbUc	Amplitude	Phase	
Ia	Amplitude	Phase	
IaIbIc	Amplitude	Phase	
Udc	Amplitude		
Idc	Amplitude		
All	Frequency		

2. Changing step: The function keys and rotary encoder is used to set changing step to control variable fluctuation.

Ua	57.735V	0°	50HZ	Only for Ua frequency
Ub	57.735V	-120°	49HZ	Only for Ub, Uc, Ia, Ib, Ic frequency

3. Alter variable value during test: single step increasing, single step decreasing: manually increase/decrease variable value according to changing step; operate rotary encoder: turn in clockwise to increase it or in anti-clockwise to decrease it; when turn the rotary encoder quickly, the variable value will change quickly as well.

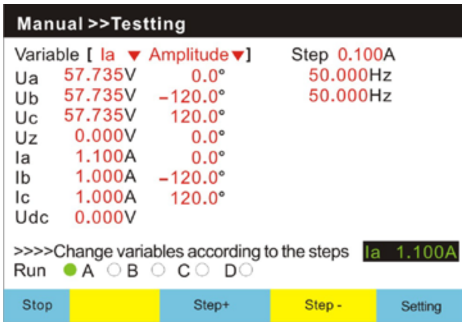


Fig. 5.1

4. Change non-variable value during test: with the test starting, press the function key for parameter setting to change the parameter that has already been set. The output won't change during this process. Press the “Change Complete” to confirm the value changed.

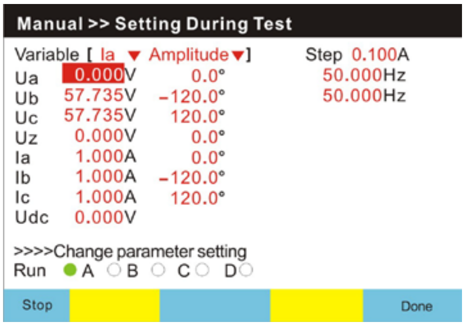


Fig. 5.2

6. Distance Test

6.1 Overview

This unit can carry out the setting check, the logic check and the switch transmission test for circuit protection.

Set fault current to carry out the setting check on zero-sequence protection and over-current protection; set short-circuit impedance to carry out the setting check on distance protection. Select fault type, do transient permanent fault check's phase selection, reclosing, reclosing post-acceleration functions, and carry out switch transmission test.

6.2 Parameters

1. Fault Type: A-phase earthing, B-phase earthing, C-phase earthing, AB short-circuit, BC short-circuit, CA short-circuit, 3-phase short-circuit
Short-circuit impedance, impedance angle: amplitude value and phase of short-circuit impedance in fault.
2. Short-circuit current: It's the magnitude of fault phase current when the tester outputs fault. According to short-circuit current, short-circuit impedance, impedance angle, zero-sequence compensatory coefficient KO, it can automatically calculate the fault phase voltage.
3. Maximum fault time: It’s the time from the fault starting to the end of the test, including trip time, reclosing time and permanent trip time, with the default value of 5s. The maximum fault time has the logical OR relationship with the time that the binary input of the tester receives the protection trip contact. For example: The tester will cut off the current as soon as it receives the outlet contact that has 50ms; if the contact didn't connect to the tester, the fault current will continue to be outputted till the maximum fault time 5s is reached.
4. K0 Calculation Method: KO is the zero-sequence compensatory coefficient. Since it's different from different manufacturer, select the right one, otherwise it will affect the earthing impedance calculation. There have 3 methods:

K0 Calculation Method	KL	RE/RX		Z0/Z1	
	KL	**KX**	**KR**	**Amplitude**	**Phase**

KL is for Nanjing Automation Research Institute (NARI) , and RE/RX is for Sifang Automation Co., Ltd and Guodian Nanjing Automation Co., Ltd.
5. PT position: The trip phase voltage will recover to the rated voltage before fault when the tester receives trip signal if the bus side is selected; the trip phase voltage will have no output when the tester receives trip signal if the line side is selected.
6. Breaker Trip/closing Time Simulation
Trip Time: When the tester receives the protection trip signal, it will switch the phase voltage and current of the tripping to the after-trip state after the trip time.
Reclosing Time: When the tester receives the protection reclosing signal, it will switch the voltage and current to the after-reclosing state after the reclosing time.
7. Fault Property: For the permanent type, the tester will give the fault selected as soon as receiving the reclosing signal; for the transient type, the tester will output the rated voltage and 0A of current as soon as receiving the reclosing signal. Note: If the permanent fault type is selected, the reclosing contact under protection must be connected to the binary input D or H of the tester.
8. Binary-out Action: ABC 3-trip, ABC 1-trip, EFG 3-trip, EFG 1-trip
Reclosing: D, H
If the split-phase tripping is selected for the protection, the trip A, B and C contacts to be protected should be connected to the corresponding A, B and C binary inputs of the tester; if the 3-phase trip

is selected, the trip contacts under protection could be connected to any of A, B and C binary inputs of the tester randomly. During the setting check, the outlet strap will open, the contact should be empty or one end of it connects to tripping and closing positive terminal and another end connects to the protection outlet, which should be via the ABC binary input on the front panel of the tester; during the switch transmission, enable the tripping and closing of the outlet strap, one end of the binary input connects to the positive power of the tripping and closing and another end connects to the protection outlet, which should be via the EFG binary-in on the back of the tester.

When ABC 3-trip or ABC 1-trip is selected as the trip contact, the reclosing contact should connect to the binary-in D of the tester; when EFG 3-trip or EFG 1-trip is selected for as the closing contact, the reclosing contact should connect to the binary-in H of the tester.

6.3 Examples

1. Test Item: Simulate the single-phase earthing permanent fault within I zone of earthing distance, and then carry out the action time, reclosing time and post-acceleration time tests.
2. Protection Information: Only enable the distance protection enabling connecting strap. Earthing impedance setting of I zone: 1Ω; Positive-sequence sensitive angle: 78°; Zero-sequence compensatory coefficient: K=0.67, enable the tripping and reclosing outlet straps.
3. Testing wiring: Connect the voltage and current outputs of the tester to the contacts to be protected correctly, since the tripping and reclosing outlet straps have been enabled, the binary-in EFGH on the back panel of the tester should be applied, one end of which connects to the trip A, B , C, and reclosing outlet respectively and another end is supplied from the positive power of the tripping and closing.
4. Parameter Setting: Short-circuit impedance=0.7IZ_{set}=0.7Ω, impedance angle=positive-sequence sensitive angle 78°, K0 calculation method: KL, amplitude=0.67, phase=0.
See below illustration.

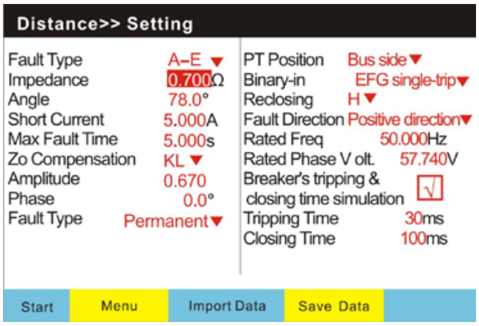


Fig. 6.1

5. Start Test
- Press “Start Test” button, the rated voltage and current outputted by the tester should be zero.
- Press the Fault button to trigger the fault, the tester will output the fault; press the stop test button to stop the test.

6. Test Result Display:
- Action Time: It’s the period from the fault starting to the time that the tester receives the protection action contact.
- Reclosing Time: It’s the period from the time that the tester receives the protection action contact to the time that the tester receives the protection reclosing contact.
- Post-acceleration Time: It’s the period from the tester receives the protection reclosing contact to the time that the tester receives the protection permanent tripping contact.

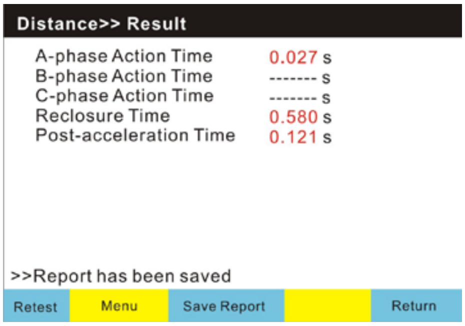

Distance>> Result
A-phase Action Time 0.027 s
B-phase Action Time ------- s
C-phase Action Time ------- s
Reclosure Time 0.580 s
Post-acceleration Time 0.121 s
>>Report has been saved
Retest
Menu
Save Report
Return

Fig. 6.2

7. State Sequence Test

7.1 Overview

This unit can control complex process flexibly: it can define 8 continuous testing states at most that can be set of its voltage, current amplitude and phase at will, switching among states by time or triggered by binary input.

7.2 Parameters

1. Total Number of States: 2-8 states are applied for setting. Control the function key of “Next State” on the right bottom of the screen to view and set any state parameters.
2. Trigger Condition: It's the condition to decide when this state should be ended.
Time Trigger: It's used to define the output time of this state, which will go to the next state when the **State Time** is finished.
Contact Trigger: When the binary input of the tester receives the protection action contact, this state will be ended and move on to next state.
3. Trigger Contact: There have 4 choices of A, B, C, ABC. When ABC is selected, ABC is in the logical OR relationship, which means only when the binary input A, B, C of the tester all receive the action contact at the same time, this state will be closed and move on to next state.
4. After-trigger Delay Time: It's applied in the breaker tripping and closing delay situation. When the trigger condition is reached, this state won't move on to next state until the delay time is passed.

7.3 Example 1

1. Test Item: Simulate A-phase earthing permanent fault in zero-sequence zone I, carrying out action time, reclosing time and post-acceleration time tests.
2. Protection Information: Only enable zero-sequence protection enabling connection strap, disable tripping, reclosing outlet straps; zero-sequence sensitive angle:78°; zero-sequence setting of zone I : 6A.
3. Test Wiring: Connect the voltage and current outputs of the tester to the terminal to be protected correctly. The binary input A and D on the front panel of the tester will be connected to the trip A to be protected with one terminal and to the positive power of the tripping and closing with another terminal.
4. Set 4 States: The total number of states is 4.

State 1: Before-fault State: rated voltage, 0A of current; time trigger: 15s.

It's used to charge reclosing.

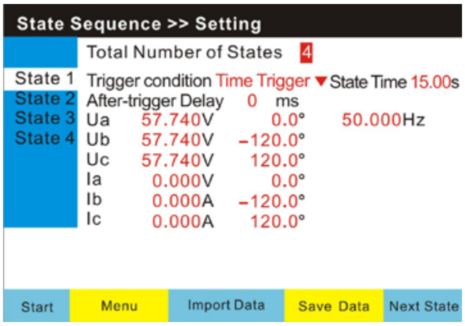


Fig. 7.1

State 2: Fault State: A-phase Current **Ia** =1.2I_{0set}=7.2A, Phase Angle= -78°, Trigger Contact A, After-trigger Delay: 30ms

After 30ms delay of that the binary input of the tester receives A-phase tripping contact to be protected, it will cut off A-phase current output in the breaker tripping time simulated and go into next state of after trigger.

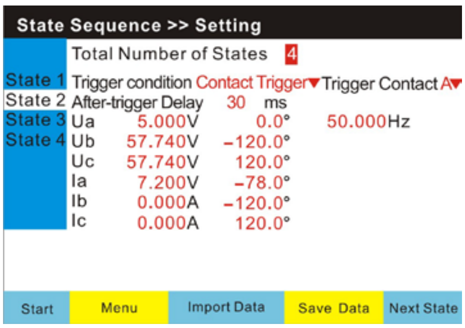


Fig. 7.2

State 3: State After Tripping: rated voltage, 0A of current, tripping contact: D

On the case that the fault is solved, the voltage will recover to the rated value and the reclosing delay is reached, after 100ms delay of the binary input D of the tester will receives the protection reclosing contact, it will go to the next permanent tripping state in the breaker closing time simulated by it.

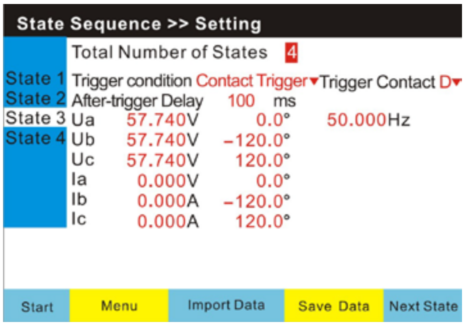


Fig. 7.3

State 4：Permanent Tripping State: A-phase current **Ia** $=1.2I_{0set}$=7.2A, Phase angle= -78°, Trigger contact: A

The tester will output the fault state as soon as entering the permanent tripping state. The protection post-acceleration will act. After 30ms delay of that binary input of the tester receives A-phase tripping contact to be protected it will cut off A-phase current output in the breaker tripping time simulated by it, and stop the test.

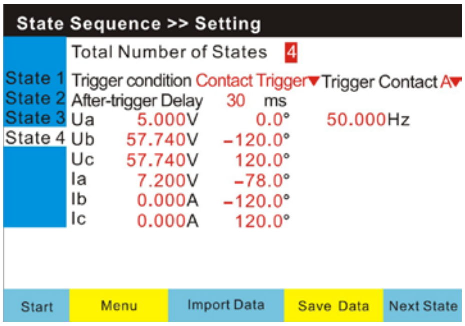


Fig. 7.4

5. The action result shows: The recording period is from the beginning of every state to its end.


Distance>> Result
State A B C D
1 ------- s ------- s ------- s ------- s
2 0.030 s ------- s ------- s ------- s
3 ------- s ------- s ------- s 0.532 s
4 0.021 s 0.030 s 0.030 s 0.030 s
Retest
Exit
Save Report
Return
Fig. 7.5

8. Inverse Time Current Protection Test

8.1 Overview

This unit is to test inverse time current protection with 2 types of methods of list and diagram to display the result. The test point can be set by users.

8.2 Parameters

1. Variables: Ia, Ia+Ib, Ia+Ib+Ic
When Ia+Ib is selected: Ia and Ib have the same phase value and are connected parallel to each other, which can output 2 times of maximum single-phase current at most. PW40D can output 80A, and PW30D can output 60A. By then 1-10 test points' currents are set to the sum of Ia+Ib.
If Ia+Ib+Ic is selected: Ia, Ib and Ic have the same phase value and connected parallel to each other, which can output 3 times of maximum single-phase current at most.
PW40D can output 120A, PW30D can output 90A. By then 1-10 test points' current is set to the sum of Ia+Ib+Ic.
2. The number of test points: 10 at most
3. Before-fault Time: It's the period during which the tester can output the 3-phase voltage setting, and by then the current output should be zero.
4. Maximum Fault Time: It's the maximum period during which the tester can output the current via certain point, which should be larger than the maximum action time of each current point. When certain current point's protection acts before the maximum action time, the tester should stop this current output immediately and go to the output breaking time.
5. Output Breaking Time: It's the time when the voltage and the current have zero output, which is applied to protect complete reset action.
6. Anti-shake Time: It's the time when the tester is trying to avoid any contact shaking. If the continuous closing time of the contact is less than the anti-shake time, it's not believed that the contact is closed well.
7. 3-phase Voltage: It's the voltage that has been outputted before and during fault. The phase sequence is positive, Ua=0°.

8.3 Example: Inverse Limit Current Test

1. Parameter Setting
Set the test points: 1A, 2A, 3A, 4A, 5A
Maximum Fault Time: 40s, which is the action time when the current is larger than the minimum value of 1A.

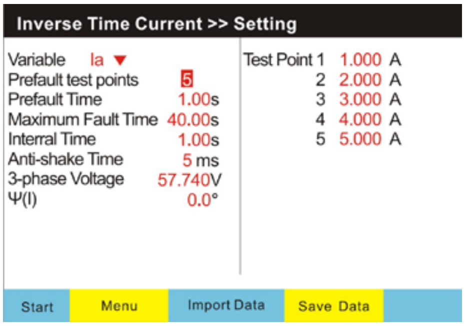


Fig. 8.1

2. Test Process
Each test point will start to output current when the before-fault time is reached and will start time-counting at the same time. When the binary input acts, the test point will stop the test, and will go to next test point within the output breaking time.
3. Test Result Displays:

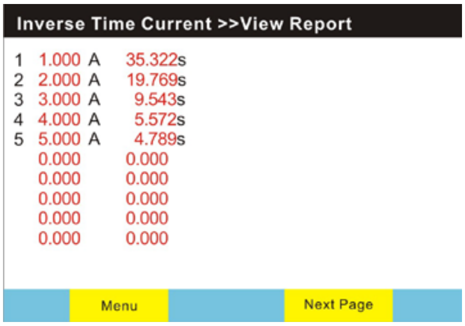


Fig. 8.2

Press “Next Page” to go to the graphical display screen for the test result.

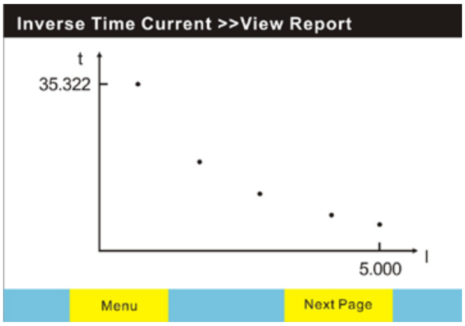

Inverse Time Current >>View Report
t
35.322
5.000
I
Menu
Next Page

Fig. 8.3

9. Frequency Action Value Test

9.1 Overview

This unit is used to carry out the automatic test on frequency action value of low-cycle load dropping.

9.2 Parameters

1. Setting frequency, setting time: Input certain protection setting values, which means the input value is identical with the protection setting value.
2. df/dt: This value should be set to be smaller than the frequency slip blocking setting so that the low-cycle load dropping outlet could be enabled.
3. 3-phase Line Voltage: It's the value of the voltage that has been outputted during test, which is the positive-sequence line voltage that is 3-phase symmetry to make easier to match with the line voltage blocking value of low-cycle load dropping. The value should be set to be larger than the voltage blocking setting value to enable the low-cycle load dropping outlet.
4. 3-phase Current: The value should be set to be larger than the current blocking value to enable the low-cycle load dropping exit.
The phases of current and voltage are the fixed at UA: 0°, UB: -120°, UC: 120°, IA: -30°, IB: -150° and IC: 90°.
5. Frequency Step: The testing accuracy of the frequency action depends on this value. Smaller the value, higher the testing accuracy, but it will take much more time. It's suggested to be 0.050Hz.

9.3 Example: Automatic Test on Low-cycle Action Value

1. Protection Setting Information: Low-cycle setting: 49Hz, action time setting value: 2s, slip blocking value: 2Hz/s, line voltage blocking value: 60V, current blocking value: 1A.
2. Test Wiring: If the blocking function for current protection is enabled, it's needed to import the current. Since it's the automatic test on low-cycle action value, the action contact to be protected should be taken the transient contact. Connect the action contact to be protected to A, B, C or D binary input terminal of the tester randomly.
3. Parameter Setting:

- Setting Frequency: 49Hz, setting time: 2s, which are the protection setting values.
- df/dt: 1Hz/s, which should be smaller than the slip blocking value to enable the low-cycle load dropping outlet.

- 3-phase Line Voltage: 100V, which is larger than the low-voltage blocking setting value to enable the low-cycle load dropping outlet.
- 3-phase Current: 1.2A, which is larger than the low-current blocking setting value to enable the low-cycle load dropping exit.

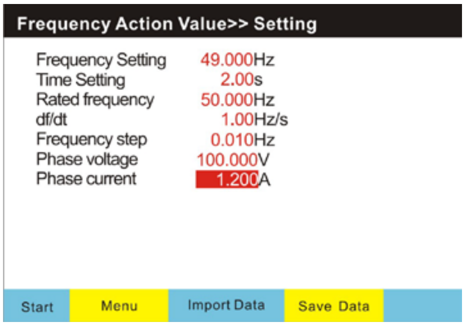


Fig. 9.1

4. When the test begins, the tester will output 100V positive-sequence line voltage, 1.2A Ia, 50Hz frequency for 3s; after the 3s, the frequency will decrease at the settled step of 1Hz/s till it reaches 49.05Hz(Setting frequency + Frequency step×5), which will be held for 2.4s (1.2 times of setting time). If the protection won't act, it will decrease from the rated frequency again to 49.04Hz for the second time. The process will repeat till the protection acts, if yes, the test should be over. If the protection won't act yet, the frequency should drop to 48.05Hz(setting value—frequency step×5) and the test will be closed by then.

5. Test Result

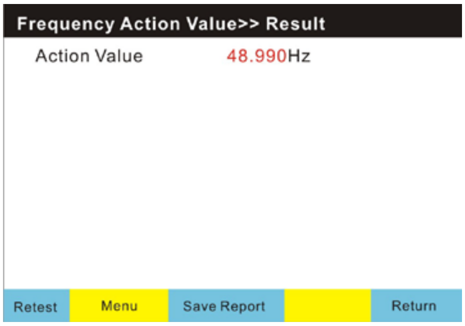


Fig. 9.2

10. Frequency Action Time Test

10.1 Overview

This unit is to carry out the automatic test on action time of low-cycle load dropping, and have fixed point tests on slip blocking value, voltage blocking and current blocking values.

10.2 Parameters

1. Setting Frequency: It's the frequency value when the tester starts time-counting, which should be set to corresponding low-frequency setting or actual action values.
2. Setting Time: Low-cycle action time setting.
3. df/dt: The value should be set to be smaller than frequency slip blocking setting value to enable low-cycle load dropping outlet.
4. 3-phase Line Voltage: It's the value of the voltage that will be outputted during test, which is the positive sequence line voltage that is 3-phase symmetry, making easier to match with the low-cycle load dropping line voltage blocking value. If the value is larger than the voltage blocking value, the low-cycle load dropping outlet will be enabled.
5. 3-Phase Current: This value should be larger than the current blocking setting value to enable the low-cycle load dropping outlet.

The current and voltage's phases are fixed at: UA: 0°, UB: -120°, UC: 120°, IA: -30°, IB: -150°, IC: 90°

10.3 Examples

10.3.1 Example 1

1. Test Item: Automatic test on low-cycle action time
2. Protection setting information: Low-cycle setting: 49Hz, action time setting value: 2s, slip setting value: 2Hz/s, line voltage blocking value: 60V, current blocking value: 1A
3. Test wiring: If the blocking function for current protection is enabled, the current must be imported. Since it's the automatic test on low-cycle action value, the action contact to be protected should be taken the transient contact. Connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester randomly.
4. Parameter Setting:

- Fixed value frequency: 49Hz, setting time: 2S, which are the protection settings.
- df/dt: 1Hz/s, which should be smaller than the slip blocking setting value to enable low-cycle load dropping outlet.
- 3-Phase Line Voltage: 100V, which should be larger than the low-voltage blocking setting value to enable the low-cycle load dropping outlet.
- 3-Phase Current: 1.2A, which should be larger than the low-current blocking setting value to enable the low-cycle load dropping outlet.
  See below illustration.

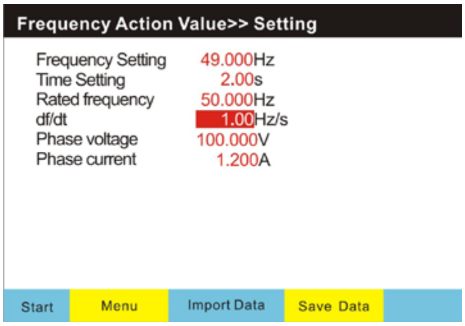


Fig. 10.1

5. When the test begins, the tester will output 100V positive-sequence line voltage, 1.2A Ia, 50Hz frequency for 3s; after the 3s, the frequency will decrease at the settled step of 1Hz/s; when it reaches 49.05Hz, the tester will start time-counting. The frequency continues to decline till the protection takes action. By then the binary input of the tester receives the protection action contact, it will stop time counting and record the action time. If the protection won't work and the time has elapsed for 1.2 times of the setting time, the test will stop. In order to avoid the too-low blocking protection caused by over-low frequency, the minimum frequency limit of the tester is set to 45Hz, which means the frequency can only decline to 45Hz as farthest. And when the time elapses for 1.2

times of the setting time, the test will stop.

6. Test Result

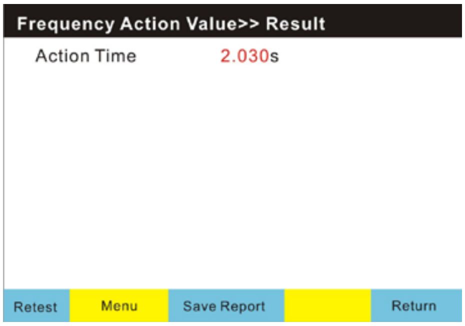


Fig. 10.2

10.3.2 Example 2

1. Test Item: Fixed-point test on slip blocking value.
2. Protection setting value information: Low-cycle setting value: 49Hz, action time setting value: 2s, slip setting value: 2Hz/s, line voltage blocking value: 60V, current blocking value: 1A
3. Test wiring: If the blocking function for current protection is enabled, the current must be imported. Since it's the automatic test on low-cycle action value, the action contact to be protected should be taken the transient contact. Connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester randomly.
4. Parameter Setting

- Fixed point test: when df/dt=1.9Hz/S, whether the low-cycle load dropping will act or not;
  Setting frequency: 49Hz, setting time: 2s, which are the protection setting values.
  df/dt: 1.9Hz/s, which should be smaller than the slip blocking setting value to enable the low-cycle load dropping outlet.
  3-Phase Line Voltage: 100V, which should be larger than the low-voltage blocking setting value to enable the low-cycle load dropping outlet.
  3-Phase Current: 1.2A, which should be larger than the low-current blocking setting value to enable the low-cycle load dropping outlet.

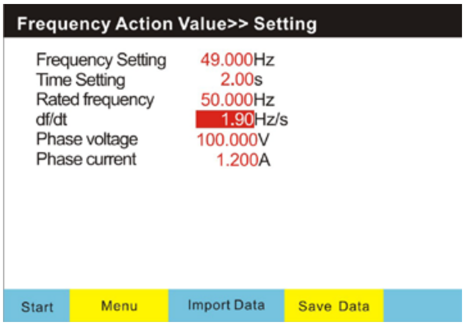


Fig. 10.3

Test Result: Low-cycle load dropping will act.

- Fixed-point test: when df/dt=2.1Hz/S, whether the low-cycle load dropping should act or not.
  Setting frequency: 49Hz, setting time: 2s, which are the protection setting values.
  df/dt: 2.1Hz/s, which should be larger than the slip blocking setting value to disable the low-cycle load dropping outlet.
  3-Phase Line Voltage: 100V, which should be larger than the low-voltage blocking setting value to enable the low-cycle load dropping outlet.
  Ia: 1.2A, which should be larger than the low-current blocking setting value to enable the low-cycle load dropping outlet.

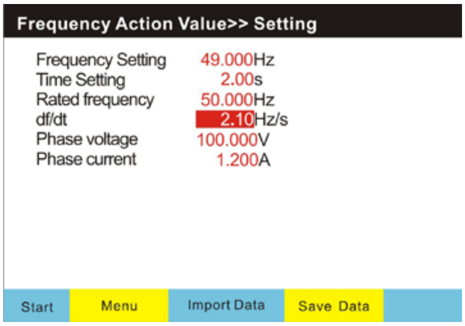


Fig. 10.4

Test Result: The Low-cycle load dropping won’t work.

- Fixed-point Test Conclusion:

On the case that the low frequency attains the exit condition and the voltage blocking and current blocking values both enable the outlets, low-cycle load dropping will act at 1.9Hz/s and won’t act at 2.1Hz/s, which tells that the slip blocking value should be within 1.9~2.1Hz/s.

10.3.3 Example 3

1. Test Item: Fixed point test on line voltage blocking value.
2. Protection setting value information: Low-cycle setting: 49Hz, action time setting value: 2s, slip setting value: 2Hz/s, line voltage blocking value: 60V, current blocking value: 1A
3. Test wiring: If the blocking function for current protection is enabled, the current must be imported. Since it's the automatic test on low-cycle action value, the action contact to be protected should be taken the transient contact. Connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester randomly.
4. Parameter Setting

- Fixed point test: when 3-phase line voltage=62V, whether the low-cycle load dropping will act or not;

  Setting frequency: 49Hz, setting time: 2s, which are the protection setting values.

  df/dt: 1Hz/s, which should be smaller than the slip blocking setting value to enable the low-cycle load dropping outlet.

  3-Phase Line Voltage: 62V, which should be larger than the low-voltage blocking setting value to enable the low-cycle load dropping outlet.

  Ia: 1.2A, which should be larger than the low-current blocking setting value to enable the low-cycle load dropping outlet.

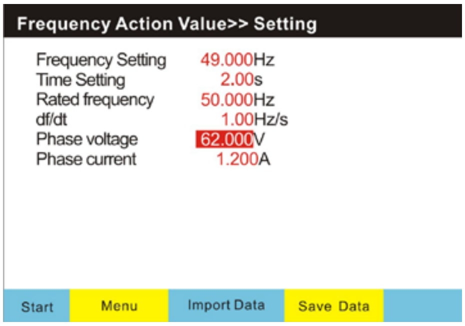


Fig. 10.5

Test Result: The low-cycle load dropping will act.

- Fixed point test: When 3-phase line voltage=58V, whether the low-cycle load dropping will act or not;

  Setting frequency: 49Hz, setting time: 2s, which are the protection setting values.

  df/dt: 1Hz/s, which is smaller than the slip blocking setting value to enable the low-cycle load dropping outlet.

  3-Phase Line Voltage: 58V, which should be smaller than the low-voltage blocking setting value to disable the low-cycle load dropping outlet.

  Ia: 1.2A, which should be larger than the low-current blocking setting value to enable the

low-cycle load dropping outlet.

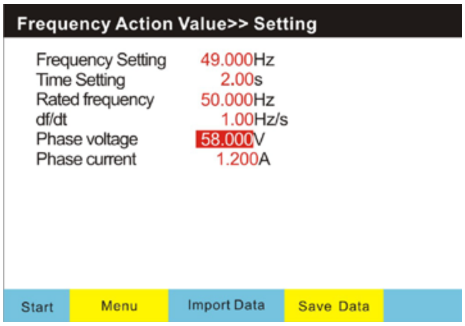


Fig. 10.6

Test Result: The low-cycle load dropping won't act.

- Fixed-point Test Conclusion:

On the case that the low frequency attains the outlet condition and the slip blocking and current blocking values both enable the outlets, the low-cycle load dropping will act at 62V and won't act at 58V, which tells that the voltage blocking value should be within 62~58V.

11. AC Action Value Test

11.1 Overview

This unit is to carry out the automatic test on AC current/voltage's action value, return value, return coefficient, action boundary at power direction, sensitive angle.

11.2 Parameters

1. Variables: There have Ua, UaUbUc, Ia, φ(Ia) for your to select.
UaUbUc are positive sequence voltages, and here Ua=0°.
2. Changing Mode: Initial—End—Initial, Initial—End

- On the case that the Initial—End—Initial mode is selected, and the variables selected are Ua, UaUbUc, Ia: these variables will change from their initial values to the end values, the protection action will jump to its end value and then change towards the initial value. When the protection returns to the initial value, the test will close. Record the action value, return value and return coefficient.
- On the case that the Initial—End—Initial mode is selected, and the variable selected is φ(Ia): the initial value and the end value of the variable should be set within the non-action zone. The variable will alter from its initial value to its end value, which will act at the boundary I; the protection will jump to the end value and then change towards its initial value, which will act at the boundary II, by then the test will close. Record the boundary I value, the boundary II value and the maximum sensitive angle.
- On the case that Initial—End is selected, the variables will always alter from their initial values to the end values. When the protection acts, the test will end. Record the action result.

3. Changing step: It's the value of which each step increases or decreases during the changing process, which can decide the testing accuracy.
4. Time step: It's the period during which one step can hold after its changing process, which should be larger than the exit time of the protection.

11.3 Example: Directional Over-current II with Low-voltage Blocking

1. Protection Setting Information: Over-current setting value: 4A, over-current delay: 0.5s, low-voltage blocking value: 60V (line voltage), directional setting value: -90°--30° (90° wiring), most

sensitive angle: -30°
90° wiring is the phase that Ubc exceeds Ia, which could be -120°--0° when it's calculated as the phase that Ia exceeds Ua with the most sensitive angle: -60°, and could be 120°--0° when it's calculated as the phase that Ua exceeds Ia with the most sensitive angle: 60°.
2. Test Wiring: Connect 3-phase voltage correctly, and connect A-phase current with the protection. Since it's an automatic test, the action contact to be protected should be taken the transient contact. Connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester randomly. Exit the over-current zone I and III to avoid any influence on the zone II during the test.
3. Test Item 1: On the case of directional over-current with low-voltage blocking, test on current action value.
Set Parameters: see below illustration.

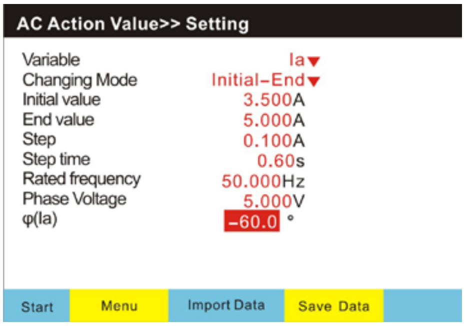


Fig. 11.1

When the test begins, the tester will output Ia=3.5A for 0.6s. If the protection doesn't act, it will output the 3.6A for 0.6s again, and this process will repeat till the protection acts. By then the tester will stop working and record the protection action value. In the foregoing current changing process: 3-Phase phase voltage=5V, the low voltage should always enable the over-current outlet; φ (Ia) =-60.0°. Since Ua=0°, the most sensitive angle= -30° of that Ubc exceeds Ia when Ia is set to -60.0°.
Test Result:

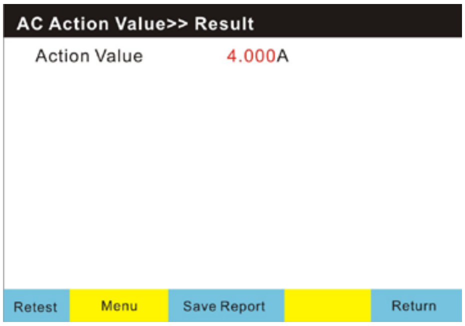


Fig. 11.2

Test Item 2: On the case of directional over-current with low-voltage blocking, test on voltage

blocking value.

Set parameters: see below illustration.

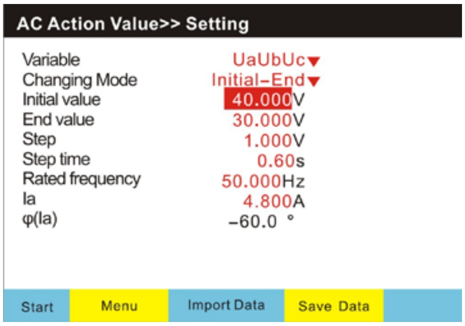


Fig. 11.3

When the test begins, the tester will output positive-sequence phase voltage=40V for 0.6s, which can be calculated as line voltage =68V and should be larger than 60V low-voltage blocking value (line voltage). If the protection doesn't act, it will decrease the phase voltage continuously to 39V and hold the value for 0.6s again, and this process will repeat till the over-current protection is enabled by the voltage. By then the tester will stop working and record current voltage value. In the foregoing voltage changing process: Ia=1.2*4A=4.8A , φ(Ia) =-60.0°: current=1.2 times of the current setting value, and the most sensitive angle should always attain the direction condition.

Test Result: Action value is the phase voltage value.

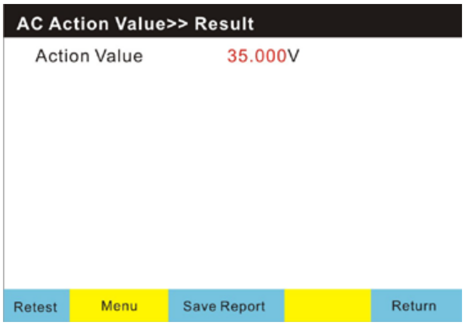


Fig. 11.4

12. AC Action Time Test

12.1 Overview

This unit is to test on AC current/voltage's action time.

12.2 Parameters

1. Before fault three-phase phase voltage: UaUbUc are positive sequence voltages, and here Ua=0°.
2. Before fault Ia and φ(Ia): the amplitude and phase values of the current that are in its normal states.
3. Time before fault: The time of the voltage and the current, which are outputted before fault.
4. Fault 3-phase phase voltage: UaUbUc are positive sequence voltages, and here Ua=0°.
5. Fault Ia, Fault φ(Ia): The amplitude and phase values of the current that are in their fault states.
6. Fault time: It's the period during which the voltage and the current in the fault states have been outputted, which should be larger than the exit delay of the protection.

When the test begins, the tester will output the variables in their before-fault states. It will start outputting the fault states and time-counting when the before-fault time is reached. When the binary inputs of the tester being connected to the action conatact stop testing, it will record the action time.

12.3 Example: On the case of directional over-current with low-voltage blocking, test on action time.

1. Protection Setting Information: Over-current setting value: 4A, over-current delay: 0.5s, low-voltage blocking value: 48V (line voltage), directional setting value: -90°--30° (90° wiring), most sensitive angle: -30°

90° wiring is the phase that Ubc exceeds Ia, which could be -120°--0° when it's calculated as the phase that Ia exceeds Ua with the most sensitive angle: -60°, or 120°--0°when it's calculated as the phase that Ua exceeds Ia with the most sensitive angle: -60°.

2. Test Wiring: Connect 3-phase voltage correctly, and connect A-phase current with the protection. Connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester randomly.

3. Parameter Setting

- Fault 3-phase phase voltage: 5V, enabling over-current with low-voltage blocking.
- Fault Ia: 4.8A. Test the over-current action time under 1.2 times of the setting value.
- Fault φ (Ia): -60.0°, which is the sensitive angle, enabling over-current at the power direction.

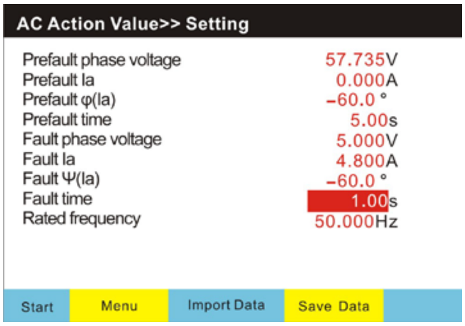


Fig. 12.1

4. Test Result:

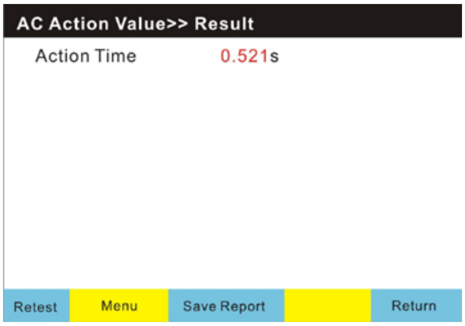

AC Action Value>> Result
Action Time
0.521s
Retest
Menu
Save Report
Return

Fig. 12.2

13. DC Action Value Test

13.1 Overview

This unit is to carry out the automatic test on DC current/voltage's action value, return value and return coefficient.

13.2 Parameters

1. Variables: Udc can be DC300V at most, and Ia can be 20A at most.
2. Changing Mode: Initial—End—Initial, Initial—End

- For Initial—End—Initial mode: the variable will alter from the initial value to the end value, the protection will jump to the end value and then alter to the initial value. When the protection returns to its initial value, the test is over. Record the action value, return value and return coefficient during the test.
- For Initial—End mode: The variable will alter from the initial value to the end value. When the protection acts, the test is over. Record the action value.
- Changing step: It's the value of which every step increases or decrease during the changing process, which can define the test accuracy.

3. Time Step: It's the period during which certain step should hold after the changing, which should be larger than the exit time of the protection.

13.3 Example: Automatic Test on Action Value, Return Value and Return Coefficient of Time Relay

1. Protection setting information: Rated voltage: 220V, action delay: 0.5s.
2. Parameter Setting

- Changing mode: Initial—End—Initial
- Initial value for variable: 0V
- End value for variable: 220V
- According to the inspection regulation of the relay: The action voltage should be larger than 70% rated voltage, the return voltage should be no less than 5% of it, and the return value may be small, so the initial value should be set low too.
  See below illustration.

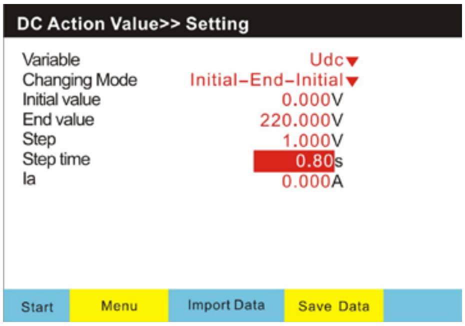


Fig. 13.1

Test Result:

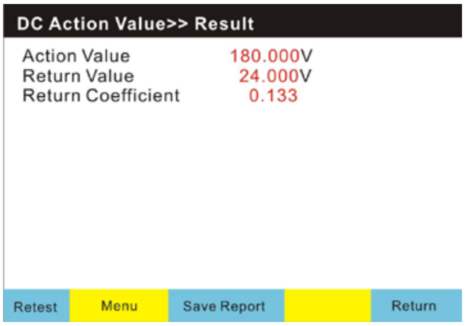


Fig. 13.2

14. DC Action Time Test

14.1 Overview

This unit is to carry out the automatic test on DC action time.

14.2 Parameters

1. Before fault Udc: Maximum value: DC300V
2. Before fault Ia: Maximum value: 20A
3. Before fault time: It's the period during which the voltage and the current before fault have been outputted.
4. Fault Udc: Maximum value: DC300V
5. Fault Ia: Maximum value: 20A
6. Fault time: It's the period during which the fault voltage and the fault current have been outputted, which should be larger than the exit time of the relay.

When the test begins, the tester will output the variables in their before-fault states. It will start outputting the fault states and time-counting when the before-fault time is reached. When the binary inputs of the tester being connected to the action conatact stop testing, it will record the action time.

14.3 Example: Action Time Test on DC Time Relay

1. Protection setting information: Rated voltage: 220V, time: 4s.
2. Test wiring: Connect the Udc of the tester to the relay voltage coil, connect the action contact to be protected to any of A, B, C or D binary input terminals of the tester.
3. Parameter Setting

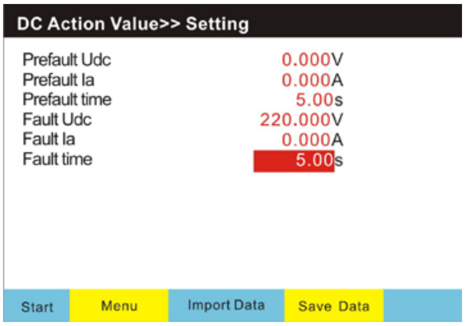


Fig. 14.1

4. Action Result:

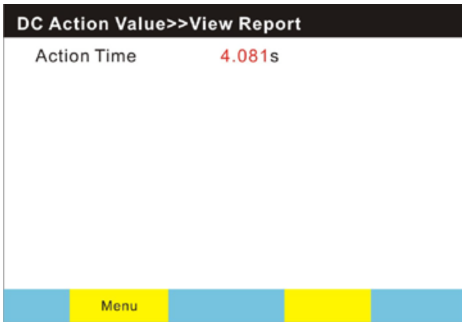


Fig. 14.2

15. PW431D-Related Products and Accessories

This chapter describes the optional equipments and accessories for the *PW431D* test set. Please visit the PONOVO Web site **www.ponovo.com.cn** for up-to-date information.

Optional accessories

Item	Part No.
AR-10 analog recording unit	SAR0101
AR-7 analog recording unit	SAR0201
PGPS02 GPS based synchronization device	SAG0101
IRIG-B based synchronization device	SAG0102
PSS01 circuit breaker simulator	SAB0101
PACB108 scanning head	SAS0101
Synchronization control cable	SAW0015
Fiber optic cable/MTRJ-ST	SAW0016
Fiber optic cable/MRTJ-MRTJ	SAW0017

Standard accessories

Item	Part No.
Color coded current cables	SAW0201/0203
Color coded voltage cables	SAW0202
Signal cables	SAW0204/0205
Flexible terminal adapter	SAW0206
Flexible jumpers	SAW0207
Crocodile clips	SAW0208
U clamps 1#	SAW0209
U clamps 2#	SAW0210
Pin clamps	SAW0211
Power cord	SAW0009
Earthing lead	SAW0018
PC control cable (LAN)	SAW0012
Transportation case	SAC0105

15.1 Analog Recording Unit (AR-10/AR-7D)

SAR0101 AR-10

SAR0201 AR-7D

The optional AR-10 or AR-7D analog recording unit can be installed on the top side. (AR-10 is installed here.)

Main specifications of *AR-10/AR-7D*

Item	AR-10	AR-7D
No. of analog recording channel	10	7
Voltage input range	0-300Vac	0-300Vac/dc
Current input range	0-30Aac	0-30Aac/dc

The optional ***AR-10 or AR-7D*** analogue signal recording unit can be installed on the top cover of the test equipment.

This facility can be used to monitor the current/voltage outputs and binary input/output status during the relay test process enabling the fast trouble shooting of wiring and test circuitry. We can also use this provision to analyze the external signals, such as phase angle, power, harmonic, etc.

15.2 PGPS02-GPS-based Synchronization Device

It provides GPS synchronization signal in PPS (pulse per second) or PPM (pulse per minute) for synchronized test. Trigger time can be set locally.

SAG0101 PGPS02

You can synchronize two or more PONOVO test sets by connecting a PGPS synchronization unit to each of the test sets' inputs.

For detailed information about the PGPS, please refer to the ***PGPS User Manual,*** the product catalog, or the PONOVO Web site www.ponovo.com.cn

Table 8-2

Pulse signal level	TTL or RS-232
Timing error between two RT GPS	TYP.<100ns MAX.<500ns
Pulse width	100ms
Weight	640g
Dimension W x H x D	95x45x160mm

15.3 IRIG-B Based Synchronization Device

It converts external IRIG-B signal into trigger pulse to synchronize several of our relay test equipment for synchronized test application.

SAG0102 PIRIG-B

Via the PIRIG-B interface box users can connect devices to the PW431D test set that either transmit or receive the IRIG-B time reference signal (DC level shift protocol B00x). That way, two or more PONOVO test sets are synchronized.

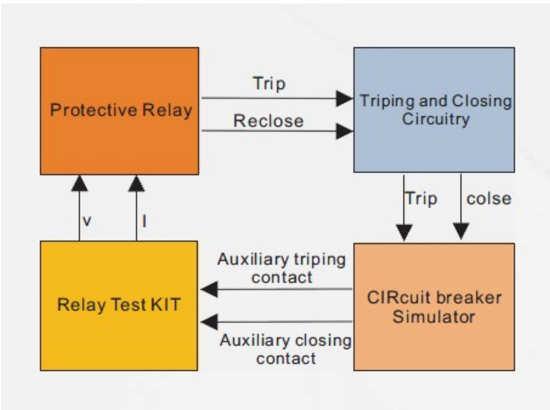
For detailed information about the PIRIG-B, please refer to the ***PIRIG-B User Manual***

15.4 PSS01 Circuit Breaker Simulator

It can simulate circuit breaker behaviors in three pole or 1 pole tripping of 6-500KV voltage grade, being available for power system, etc. It provides 12 circuit breaker auxiliary contacts for complex test applications.

SAB0101 PSS01

This is one of the application examples:



15.5 PACB108 Scanning Head

The passive optical scanning head PACB108 detects the status of an LED, that is either an optical pulse output from an energy meter or the binary status of a protective relay or other similar optical source.

SAS0101 PACB108

Output pulse: 5V or 24V
Sampling distance: 10-30 mm
Maximum sampling pulse: 100 pulses/second

15.6 Synchronization Control Cable

Synchronization control cable is used to connect more relay test kits for synchronized control.

SAW0015 Synchronization control cable

15.7 Fiber Optic Cable

SAW0016/SAW0017 Fiber Optic Cable

MTRJ-ST MTRJ-MTRJ

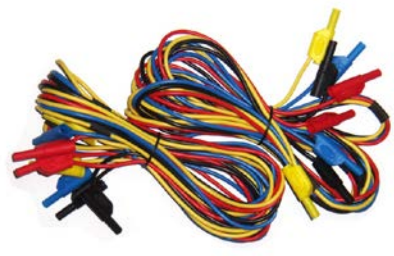
When PW431D is connected with a fiber switcher, fiber optic cables are required.

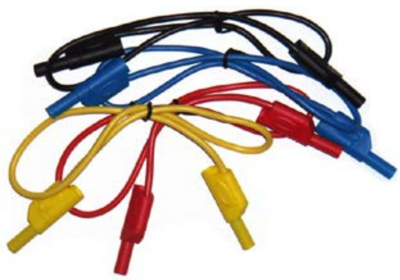
15.8 Standard Accessories

15.8.1 Soft Bag for Test Leads

The PW431D Wiring Accessory Package contains the following articles:

1. Colour coded current cables



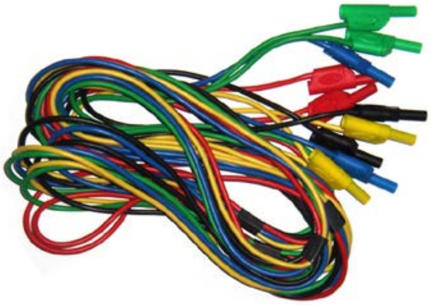


SAW0201/ 0203 colour coded current cable

Amount: 2xred, 2xblack, 2xyellow, 2xblue 1xred, 1xblack, 1xyellow, 1xblue

The current cables to connect the PW431D output to other safety sockets of, generally the current parts, voltage and signal tripping.

2. Color coded voltage cables



SAW0202 Colour coded voltage cable

Amount: Amount: 1x red, 1x yellow, 1x green, 1x blue, 1x black

The voltage cables to connect the PW431D output to other safety sockets of, generally the voltage parts, current and signal tripping.

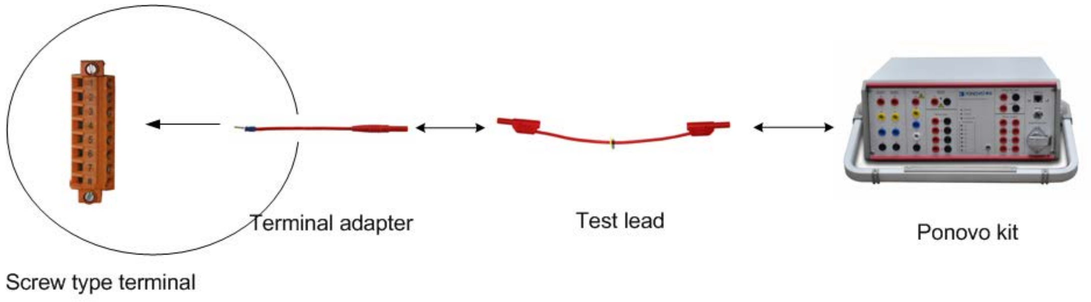
3. Signal Cable

SAW0204/0205 Signal cables

Amount: 2xred, 2x black 2xred, 2xblack

It connects the PW431D with other different sockets, generally with signal tripping and current/voltage testing.

4. Flexible Terminal Adapter



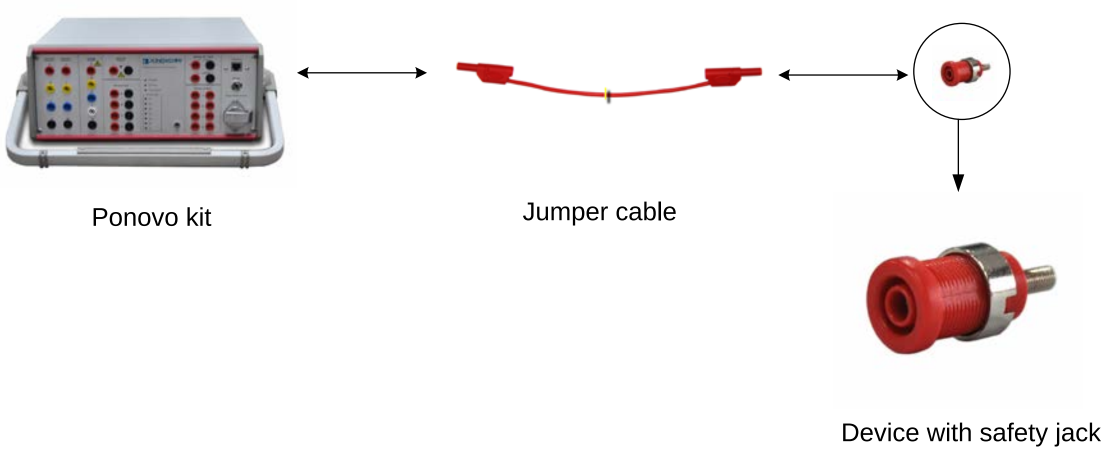
SAW0206 Flexible terminal adapter

Amount: 10xred, 10xblack

Flexible terminal adapter connect to screw-clip terminals.

Notes: One end of the adapters have no insulator, users should make sure there is no output during connecting the adapters. Users insert the non-safety into the terminals and screw it firmly, then connect the test lead with the other end.

5. Jumper Cable

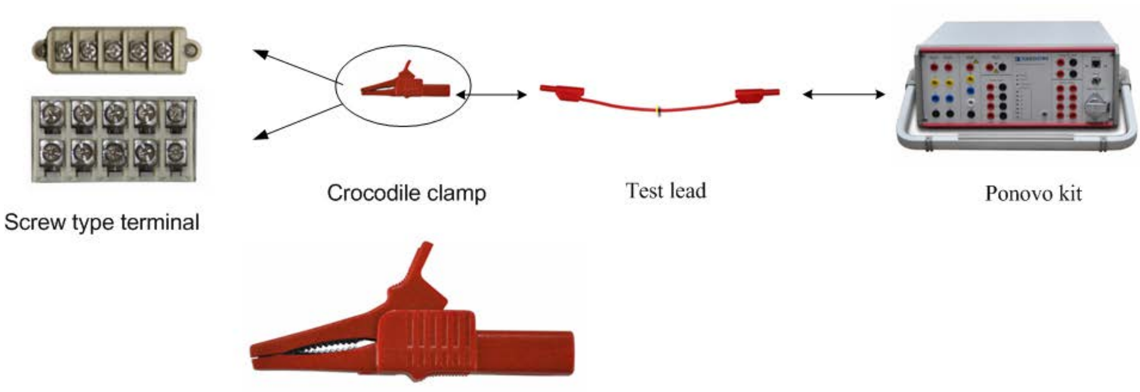


SAW0207 Flexible jumpers

Amount: 4xblack

Flexible jumper connects current outputs in parallel.

6. Crocodile Clips



SAW0208 Crocodile clips

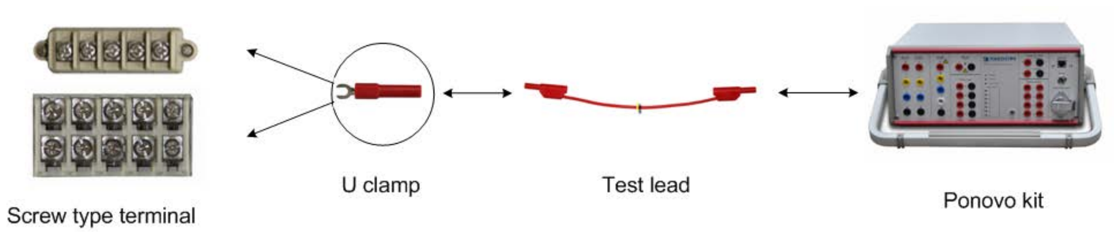
Amount: 2xred, 2xblack, 2xyellow, 2xblue

Crocodile clips for secondary side to connect to pins or screw types.

7. U Clamps

SAW0209 U clamps 1#　　　　SAW0210 U clamps 2#

Amount:　10xred, 10xblack　　　　5xred, 5xblack



It is used to connect test leads with screw type terminals.

Notes: One end of the adapters have no insulator, users should make sure there is no output during connecting the adapters. Users insert the non-safety into the terminals and screw it firmly, then connect the test lead with the other end.

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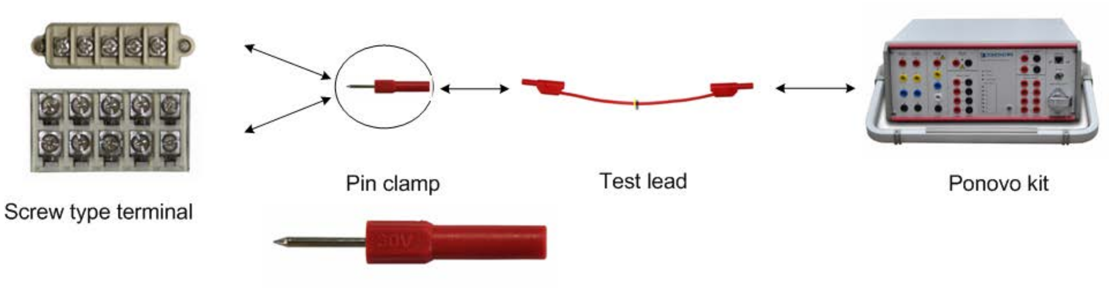
8. Pin clamps



SAW0211 Pin clamps

Amount: 4xred, 4xblack

It is used to connect test leads with screw type terminals.

9. Power Cord

SAW0009 Power code

Amount: 1 piece

Power cord connects the PW431D with power supply socket. PONOVO will provide relevant plug socket according to different countries. For the plug socket information, please check the ***Chapter 16. Appendix.***

10. Earthing Lead

SAW0018 Earthing lead

Specification: 2.5mm²×4m

Amount: 1 piece

Earthing lead connects the PW431D with ground to ensure kit safety.

Notes: In order to avoid static induction, users should connect the PW431D with ground reliably before testing.

11. PC control cable (LAN)

SAW0012 PC control cable (LAN)

Amount: 1 piece

The LAN cable connects the PW431D with PC for communications.

15.8.2 Transportation Case

The large-size case with wheels is designed for heavy transport stress with folding hand it is made of fireproof materials and smooth rolling rubber tires.

SAC0105 Transportation case

Dimension: 465x250x525mm (WxHxD)
Weight: 10Kg

16. Appendix

In order to assure PONOVO sockets are used smoothly in foreign countries, PONOVO provides the plug sockets to our customers in different countries.

The followings are the sockets used in different countries.

1. Plug Type B

Type B adapter is mainly used in America, Canada and Taiwan etc.

2. Plug Type I Adapter

The UK type plug is mainly used in United Kingdom, India, Pakistan, Thailand, Malaysia, Singapore, New Zealand and Hong Kong etc.

3. Plug Type L Adapter

Type L Adapter is mainly used in South Africa and British Standard 15A.

4. Plug Type N Adapter

This adapter is mainly used in Italy.

5. Type G Adapter

Type G Adapter is mainly used in German, Finland, France, Norway, Sweden, Poland, South Korean, Austria, Spain, Hungary, Czech, Ukraine, Turkey, Brazil and Russia etc.